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Soil Guideline Values for selenium in soil

Science Report SC050021 / Selenium SGV

This technical note is one in a series that describe Soil Guideline Values (SGVs) for individual, or groups of similar, chemicals to assist in the assessment of risks from land contamination.

SGVs are an example of generic assessment criteria (Defra and Environment Agency, 2004) and can be used in the preliminary evaluation of the risk to human health from long-term exposure to chemicals in soil. Specifically, this note provides SGVs for selenium and its inorganic compounds in soil.

The SGVs and the additional advice found here should be used only in conjunction with the introductory guide to the series entitled *Using Soil Guideline Values* (Environment Agency, 2009a), the framework documents *Updated technical background to the CLEA model* (Environment Agency, 2009b) and *Human health toxicological assessment of contaminants in soil* (Environment Agency, 2009c) and *Contaminants in soil: updated collation of toxicological data and intake values for humans. Selenium*. (Environment Agency, 2009d). Supplementary information on selenium is also available (Environment Agency, 2009e).

All notes in the SGV series, the introductory guide and further supplementary information can be downloaded from our website (<http://www.environment-agency.gov.uk/clea>).

Selenium and its inorganic compounds

Elemental selenium (CAS No. 7782-49-2) can exist in several allotropic states. The grey or hexagonal form is stable at ordinary room temperature. The other important allotropes are red (monoclinic) selenium and amorphous selenium – the latter existing in red and black forms (ATSDR, 2003, Kabata-Pendias and Mukherjee, 2007). The six naturally occurring stable isotopes of selenium are ^{74}Se , ^{76}Se , ^{77}Se , ^{78}Se , ^{80}Se and ^{82}Se with approximate abundances of 0.87, 9.02, 7.58, 23.52, 49.82, and 9.19% respectively (Hoffmann and King 1997).

Selenium may be classified as a metalloid element, with chemistry similar to sulphur. The -2, +4 and +6 oxidation states of selenium are all commonly found in nature, though other oxidation states are possible for selenium (IPCS, 1987; ATSDR, 2003). Some of its chemical forms are volatile, such as hydrogen selenide (IPCS, 1987).

Selenium combines with oxygen to form several substances that form white or colourless crystals (ATSDR, 2003).

The global production of selenium was 2,310 tonnes in 1995 (Kabata-Pendias and Mukherjee, 2007).

Selenium and its inorganic compounds are used (IPCS, 1987, ATSDR, 2003):

- in the production of glass and pigments (for paints, plastics and inks);
- in rectifiers for home entertainment equipment;
- in photoelectric cells and some photographic devices;
- in vulcanising agents for rubber;
- as a catalyst in the preparation of pharmaceuticals;
- in some licensed medicines and a variety of food supplements (specifically, selenium sulphide and disulphide are used in the manufacture of veterinary medicines);
- as a fungicide; and
- as anti-dandruff ingredients (selenium sulphide and disulphide) in shampoos.

Selenium is an essential element (micronutrient) for animals and humans and is used as a nutritional additive for livestock and poultry (IPCS, 1987; ATSDR, 2003). It has been extensively investigated with regard to both toxicity and deficiencies in humans and livestock (Kabata-Pendias and Mukherjee, 2007; Environment Agency, 2009d).

Potential harm to human health

The principles behind the selection of Health Criteria Values (HCVs), and the definition of concepts and terms used, are outlined in *Human health toxicological assessment of contaminants in soil* (Environment Agency, 2009c). Specific information on the toxicity of selenium and its inorganic compounds is reviewed in *Contaminants in soil: updated collation of toxicological data and intake values for humans. Selenium* (Environment Agency, 2009d) and only a brief summary is presented here.

Adverse effects on human health occur from both too much and from too little exposure to selenium.

Excess selenium can result in pathological changes to the hair and nails (selenosis), skin lesions and neurological effects. Convulsions and paralysis may also develop. The milder features of this selenosis are thought to occur at an oral dose in adults of about $910 \mu\text{g day}^{-1}$. There is expert group consensus that the dose–response of the selenosis is the critical feature in the definition of an oral HCV.

Diseases affecting the heart and bones develop in populations with grossly insufficient intakes of selenium. To maintain good health, the World Health Organization (WHO) recommends minimum selenium oral intakes of $33\text{--}34 \mu\text{g day}^{-1}$ for adult males and $25\text{--}26 \mu\text{g day}^{-1}$ for adult females ($35\text{--}42 \mu\text{g day}^{-1}$ for lactating females). These intakes are equivalent to $0.47\text{--}0.49 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$ for adult males, $0.42\text{--}0.43 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$ for adult females and $0.58\text{--}0.7 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$ for lactating females (assuming an adult male bodyweight of 70kg and female body weight of 60kg).

Table 1

Recommended Health Criteria Values and estimated background adult intakes for selenium (Environment Agency, 2009d)

Parameter	Selenium [†]
$\text{TDI}_{\text{oral}}, \mu\text{g kg}^{-1} \text{ bw day}^{-1}$	6.4
$\text{MDI}_{\text{oral}}, \mu\text{g day}^{-1}$	35
$\text{TDI}_{\text{inh}}, \mu\text{g kg}^{-1} \text{ bw day}^{-1}$	–
$\text{MDI}_{\text{inh}}, \mu\text{g day}^{-1}$	0.06

Note: [†] Specifically excluded are selenium sulphides.

bw = bodyweight

MDI = mean daily intake

HCVs for selenium and its inorganic compounds are summarised in Table 1.

The UK Expert Group on Vitamins and Minerals estimates that a daily oral dose of $450 \mu\text{g}$ of selenium would not pose a significant risk to the health of an adult (this is equivalent to $6.4 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$ based on a

default adult bodyweight of 70 kg). This is recommended as the oral tolerable daily intake (TDI).

The milder signs of selenosis might be expected to develop at exposures as low as twice the oral TDI, i.e. at around $13 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$.

The oral TDI is not applicable to selenium in the form of selenium sulphides due to their proven liver carcinogenicity in rodents.

The adult oral mean daily intake (MDI) for selenium from food and water combined is $35 \mu\text{g day}^{-1}$ (Environment Agency, 2009d). This is equivalent to $0.5 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$ for a 70 kg adult. For 20 kg child (aged six) who ingests 74% of the adult dietary intake (Environment Agency, 2009c), the estimated daily oral intake would be $1.3 \mu\text{g kg}^{-1} \text{ bw day}^{-1}$. Background oral exposures therefore amount to less than half the oral TDI.

There are no expert group evaluations of inhalation or dermal exposure to selenium, and data for these routes appear very limited (Environment Agency, 2009d). In view of the uncertainties around inhalation toxicity, and since oral exposure dominates risk assessment of selenium in soil, no inhalation TDI is proposed (Environment Agency, 2009d). Dermal and inhalation exposure have been compared to the oral HCV in deriving the SGVs.

The adult inhalation MDI is $0.06 \mu\text{g day}^{-1}$ (Environment Agency, 2009d).

Exposure assessment

Occurrence in soil

Elemental selenium occurs rarely in rocks and soils. Usually selenium is found combined with other substances (IPCS, 1987, ATSDR, 2003). Common minerals include sodium selenite, sodium selenate and potassium selenite (ATSDR, 2003). Selenium abundance in the Earth's crust is unevenly distributed and in the range $0.05\text{--}0.5 \text{ mg kg}^{-1}$ (Kabata-Pendias and Mukherjee, 2007).

Major sources of selenium compounds added to the environment include the burning of fossil fuels (particularly coal) and the mining and refining of copper and other metals (IPCS, 1987).

Selenium soil chemistry is dominated by selenates, selenites and selenides (Kabata-Pendias and Mukherjee, 2007).

Sulphur does not react easily with selenium, though this can occur at elevated temperatures (Greenwood and Earnshaw, 1998) and selenium can be present in other metal sulphides. There is unlikely to be a significant anthropogenic input of selenium sulphide into soil (CCME, 2007). Texts on selenium soil chemistry (Neal, 1995; Kabata-Pendias and Mukherjee, 2007) do not include selenium sulphide in any pH/redox stability diagrams.

The UK Soil and Herbage Survey (UK SHS) is a comprehensive survey of the concentrations of major

contaminants in soils and herbage across the UK. The UK SHS analysis of rural soils found mean concentrations of selenium of 1.3 mg kg^{-1} in England, 3.13 mg kg^{-1} in Scotland and the highest in Wales at 3.3 mg kg^{-1} (Environment Agency, 2007). The rural soils examined showed relatively high selenium concentrations in Wales and Scotland, and outside the range 0.2 to 1.8 mg kg^{-1} reported by Adriano (2001). Concentrations in urban soils were below the limit of detection in sampled Scottish soils. No further values were reported for selenium concentration in UK urban soils.

Behaviour in the soil environment

Recommended values for chemical data used in the exposure modelling of selenium and its inorganic compounds are provided in Table 4. Further information about the selection of chemical properties and the derivation of the soil-to-plant concentration factors for selenium can be found in *Supplementary information for the derivation of SGVs for selenium* (Environment Agency, 2009e).

In soil, elemental selenium is essentially insoluble and may represent a major inert 'sink' for selenium compounds introduced into the environment under anaerobic conditions (ATSDR, 2003).

The main forms of selenium in soil are selenate (Se^{6+}), selenite (Se^{4+}) and selenide (Se^{2-}). Their proportions in soil solution are governed by various physical-chemical properties including pH and oxidation potential, and biological processes (Kabata-Pendias and Mukherjee, 2007). Selenites and selenates in soil tend to be adsorbed on clay particles, iron and manganese minerals, and organic matter (Environment Agency, 2007).

Selenates occur under oxidising conditions and are very weakly adsorbed to soils at alkaline pH. Due to their high solubility, selenates are very mobile in normal and alkaline soil conditions (ATSDR, 2003).

Selenites occur under mildly reducing conditions and are readily sorbed onto hydrous sesquioxides and organic matter, and/or precipitated as iron complexes. In acidic soils, selenium is usually found as selenite bound to these mineral components (IPCS, 2003).

In poorly drained and acidic soils (i.e. very reducing conditions), immobile selenides are likely to form (ATSDR, 2003; IPCS, 2003; Kabata-Pendias and Mukherjee, 2007). Organic matter has a strong tendency to form organo-metallic complexes which remove selenium as heavy metal selenides from soil solution (ATSDR, 2003; Kabata-Pendias and Mukherjee, 2007).

Volatile selenium compounds can be formed by the methylation of elemental selenium and inorganic selenium compounds (such as sodium selenite). The volatile selenium compounds that partition into the atmosphere include the inorganic compounds, selenium dioxide and hydrogen selenide, and the organic

compounds, dimethyl selenide and dimethyl diselenide (ATSDR, 2003; Kabata-Pendias and Mukherjee, 2007).

The transformation of inorganic selenium into volatile species is strongly dependent on temperature and on the concentration and chemical form of the selenium. Elemental selenium is converted the slowest and organic compounds the fastest – more than selenite or selenate (ATSDR, 2003). Methylated forms of selenium are unstable in water and are expected to be lost rapidly from soils (ATSDR, 2003).

Selenium is taken up by plants from soil as selenate or selenite (Kabata-Pendias and Mukherjee, 2007). Selenates tend to be taken up more readily than selenites, in part because selenites tend to adsorb more strongly to soils (ATSDR, 2003).

There is a wide variation in uptake between different types of plants. Selenium can be phytotoxic and causes interveinal chlorosis and black spots in crop plants (Environment Agency, 2009e). At high tissue concentrations, complete bleaching or yellowing of younger leaves may occur and pinkish spotting may be observed on the roots (Kabata-Pendias, 2001; Kabata-Pendias and Mukherjee, 2007).

Some selenium tolerant plants (such as cruciferous plant species, for example; cabbage, broccoli and cauliflower) are capable of concentrating selenium up to extremely high tissue levels of over $1,000 \text{ mg kg}^{-1}$; food crops generally have a low selenium tolerance (ATSDR, 2003; Kabata-Pendias and Mukherjee, 2007). For sensitive plant species, Kloke *et al.* (1984) reported that the critical soil concentration of selenium for inhibiting plant growth is between 10 and 20 mg kg^{-1} .

Plant uptake is also related to several environmental factors such as climate, soil properties including mineral composition and availability of selenium for uptake (Kabata-Pendias and Mukherjee, 2007). The pH, is the most important of the soil properties affecting plant uptake resulting in greater availability of selenium at increasingly alkaline conditions (Environment Agency, 2009e).

Although no literature values or information relating to the dermal absorption of selenium from soil have been found, selenium and its inorganic compounds are unlikely to be absorbed through human skin (CCME, 2007). In the absence of a literature value, the default value for the dermal absorption fraction (ABS_d) for inorganic chemicals of 0 has been used (Environment Agency, 2009b).

A review of the literature found no data that could be used to provide a generalised selenium soil-to-dust transport factor. In the absence of a contaminant specific soil-to-dust transport factor, the default value of 0.5 g g^{-1} dry weight (DW) has been used (Environment Agency, 2009b).

Soil Guideline Values

Soil Guideline Values for elemental selenium and its inorganic compounds are presented according to land use in Table 2. Note that the selenium sulphides are not

included because of their markedly different toxicity (Environment Agency, 2009d).

For residential and allotment land uses, SGVs are based on estimates representative of exposure of young children because they are generally more likely to have higher exposures to soil contaminants. Further information on the default exposure assumptions used in the derivation of SGVs can be found in *Updated technical background to the CLEA model* (Environment Agency, 2009b).

The SGVs are based on a consideration of the oral, dermal and inhalation exposure routes. In the absence of an inhalation TDI, inhalation exposure has been compared to the oral HCV.

Modelling suggests that:

- the ingestion of soil and indoor dust is the most significant exposure pathway for the residential and commercial and use.
- the consumption of homegrown produce is the most significant exposure pathway for the allotment land use.
- for all standard land uses the contribution to exposure from dermal contact, vapour inhalation and outdoor dust inhalation is negligible.
- for the residential and commercial land uses percentage exposure contribution from inhalation of indoor dust is negligible.

The proportion of exposure attributable to each individual pathway for each standard land-use is summarised in Table 3.

Analytical limits of detection¹ for selenium in soil are dependent on the analytical technique used, ranging from 0.1 to 3.0 mg kg⁻¹ DW, with limits of quantification² ranging from 0.5 to 15 mg kg⁻¹ DW. MCERTS³ accredited analytical methods for selenium in soil are available.

Care should be taken when evaluating risks at soil concentrations above the SGV because clinical effects of selenosis (involving changes to the hair and nails) could be observed from as little as twice the SGV level (Environment Agency, 2009d).

The natural prevalence of selenium sulphides is expected to be low in the soil environment. However, assessors should carefully consider whether there is any evidence that selenium sulphide compounds are likely to be present in the soil by examining the site history during the desk study stage of preliminary risk assessment (Environment Agency, 2004). The outline conceptual model should include an indication whether anthropogenic sources may have introduced selenium

Table 2

The Soil Guideline Values for selenium and its inorganic compounds presented in this table should only be used in conjunction with the information contained in this technical note and with an understanding of the exposure and toxicological assumptions contained in *Updated technical background to the CLEA model* (Environment Agency, 2009b), *Human health toxicological assessment of contaminants in soil* (Environment Agency, 2009c) and *Contaminants in soil: updated collation of toxicological data and intake values for humans. Selenium* (Environment Agency, 2009d).

Land use	Soil Guideline Value (mg kg ⁻¹ DW) ^{1,2,3}
	Selenium
Residential	350
Allotment	120
Commercial	13,000

- Notes
- ¹ Figures are rounded to one or two significant figures.
 - ² Based on a sandy loam soil as defined in Environment Agency (2009b) and 6% soil organic matter (SOM).
 - ³ Based on oral, dermal and inhalation exposure pathways.

sulphides into the soil because they are used in some manufactured products. In such cases, further assessment may be required to determine the type and amount of sulphide compound present, and to consider the available toxicological data for selenium sulphides.

The availability of selenium and its inorganic compounds to garden fruit and vegetables depends on a number of complex factors. The soil-to-plant concentration factors used in the derivation of the SGV are based on a geometric mean value calculated from a review of field and experimental studies (Environment Agency, 2009e). In circumstances where the SGV is exceeded and the consumption of produce is a significant pathway, assessors may wish to consider the likely forms of selenium in the soil and factors such as pH, the presence of minerals such as iron oxides / hydroxides and soil organic matter (SOM) in any evaluation of the likelihood of exposure via this pathway. As noted previously, selenium will be generally more available for plant uptake in alkaline soils. Under typical soil conditions, selenate forms will also be more available than selenite forms. In the presence of iron minerals, the selenium may be more strongly adsorbed and will therefore be less available for plant uptake. Where appropriate, further investigation (including the sampling and chemical analysis of edible parts of fruits and vegetables) could be undertaken to establish site specific plant concentration factors.

¹ The amount of a substance that can be detected, but not quantitatively measured.

² Amount present of a substance that can be quantitatively measured.

³ Environment Agency's Monitoring Certification Scheme.

Table 3

Contribution to total exposure from soil for the relevant pathways expressed as a percentage, calculated by the CLEA software.

Exposure pathway	ADE: HCV Ratio		
	Residential	Allotment	Commercial
Oral ADE to HCV ratio at SGV ³	1.0	1.0	1.0
Inhalation ADE to HCV ratio at SGV	0	0	0
	Contribution to exposure¹ from soil according to land-use (%)		
	Residential	Allotment	Commercial
Ingestion of soil and indoor dust ²	40.6	3.8	91.6
Consumption of produce and attached soil	28.5	65.4	NA
Dermal contact (indoor and outdoor)	0	0	0
Inhalation of dust (indoor)	0.1	NA	0.6
Inhalation of dust (outdoor)	0	0	0
Inhalation of vapour (indoor)	0	NA	0
Inhalation of vapour (outdoor)	0	0	0
Oral background	30.8	30.8	7.8
Inhalation background	0	0	0

Notes ¹ Rounded to one decimal place

² Treated as one pathway (see, Environment Agency, 2009b)

³ Oral ADE to HCV ratio where ADE from all pathways has been compared to oral HCV

ADE = Average Daily Exposure

HCV = Health Criteria Value

NA = Not applicable (this exposure pathway is not included in the generic land use)

Table 4

Recommended chemical data for selenium (at 10°C unless stated)

Chemical property	Selenium and its inorganic compounds	
Air–water partition coefficient, dimensionless	NA	
Dermal absorption fraction, dimensionless	0	Environment Agency (2009e)
Diffusion coefficient in air, $\text{m}^2 \text{s}^{-1}$	NA	
Diffusion coefficient in water, $\text{m}^2 \text{s}^{-1}$	NA	
Octanol–water partition coefficient (log), dimensionless	NA	
Organic carbon–water partition coefficient (log), $\text{cm}^3 \text{g}^{-1}$	NA	
Relative molecular mass, g mol^{-1}	NA	
Soil–water partition coefficient, $\text{cm}^3 \text{g}^{-1}$	50	Environment Agency (2009e)
Vapour pressure, Pa	NA	
Water solubility, mg L^{-1}	2,170,000 (25°C)	Environment Agency (2009e) for potassium selenite
Soil-to-dust transport factor, $\text{g g}^{-1} \text{DW}$	0.5	Environment Agency (2009b)
Soil-to-plant concentration factor, $\text{mg kg}^{-1} \text{FW}$ per $\text{mg kg}^{-1} \text{DW}$		
Green vegetable produce	1.08 E-02	Environment Agency (2009e)
Root vegetable produce	3.64 E-03	Environment Agency (2009e)
Tuber vegetable produce	8.30 E-04	Environment Agency (2009e)
Herbaceous fruit produce	2.71 E-03	Environment Agency (2009e)
Shrub fruit produce	3.00 E-03	Environment Agency (2009e)
Tree fruit produce	3.00 E-03	Environment Agency (2009e)

DW = dry weight

FW = fresh weight

NA = not applicable because the CLEA model does not require these values in the derivation of assessment criteria for inorganic chemicals.

References

ADRIANO, D.C., 2001. *Trace Elements in Terrestrial Environments* (2nd edn.). New York: Springer.

ATSDR, 2003. *Toxicological profile for selenium*. Atlanta: US Department of Health and Public Services, Agency for Toxic Substances and Disease Registry. Available from: <http://www.atsdr.cdc.gov/toxprofiles/tp92-p.pdf> [Accessed October 2008].

CCME, 2007. *Canadian Soil Quality Guidelines: Selenium. Environmental and human health. Scientific supporting document*. Winnipeg: Canadian Council of Ministers of the Environment.

DEFRA and ENVIRONMENT AGENCY, 2004. *Model procedures for the management of land contamination*. Contaminated Land Report 11. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2007. *UK Soil and Herbage Pollutant Survey. Report No. 7: Environmental concentrations of heavy metals in UK soil and herbage*. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2009a. *Using Soil Guideline Values*. Science Report SC050021/SGV introduction. Bristol: Environment Agency.

Environment Agency, 2009b. *Updated technical background to the CLEA model*. Science Report SC050021/SR3. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2009c. *Human health toxicological assessment of contaminants in soil*. Science Report SC050021/SR2. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2009d. *Contaminants in soil: updated collation of toxicological data and intake values for humans. Selenium*. Science Report SC050021/SR TOX10. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2009e. *Supplementary information for the derivation of SGVs for selenium*. Science Report/ Technical Review Selenium. Bristol: Environment Agency.

GREENWOOD, N.N., and EARNSHAW, A., 1998. *Selenium, tellurium and polonium*. In *Chemistry of the Elements* (2nd edn.), Chapter 16, pp. 747-788. Oxford: Butterworth-Heinemann.

HOFFMAN, J.E. and KING, M.G., 1997. *Selenium and selenium compounds*. In *Encyclopedia of Chemical Technology* (ed. J.I. Kroschwitz and M.H. Howe-Grant), pp. 686-719. New York: John Wiley & Sons [cited in ATSDR 2003].

IPCS, 1987. *Selenium*. Environmental Health Criteria 58. Geneva: World Health Organization/ International Programme on Chemical Safety. Available from:

<http://www.inchem.org/documents/ehc/ehc/ehc58.htm> [Accessed October 2008].

KABATA-PENDIAS, A., 2001. *Trace Elements in Soils and Plants* (3rd edn.). Boca Raton, FL: CRC Press.

KABATA-PENDIAS, A. and MUKHERJEE, A.B., 2007. *Trace Elements from Soil to Human*. Berlin: Springer-Verlag.

KLOKE, A., SAURBECK, D. and Vetter, H., 1984. *The contamination of plants and soils with heavy metals and the transport of metals in terrestrial food chains*. In *Changing Metal Cycles and Human Health* (ed. J.O. Nriagu). Berlin/New York: Springer-Verlag.

NEAL, R.H., 1995. *Selenium*. In *Heavy Metals in Soils* (2nd edn.) (ed. B.J. Halloway). London: Blackie Academic & Professional.

WHO, 2003. *Selenium in drinking-water. Background document for development of WHO Guidelines for Drinking-Water Quality*. Geneva: World Health Organization.

Publication Information

This technical note presents information from Science Project SC050021.

Project manager:

Jo Jeffries, Science, Head Office

This work was funded by the Environment Agency's Science Department, which provides scientific knowledge, tools and techniques to enable us to protect and manage the environment as effectively as possible.

Published by:

Environment Agency, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD.

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Dissemination Status:

Released to all regions
Publicly available

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The CLEA Guidance incorporates the following

- 1) *Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil*
- 2) *Science Report SC050021/SR3: Updated technical background to the CLEA model*
- 3) *Science Report SC050021/SR4: CLEA Software (Version 1.04) Handbook*
- 4) *CLEA Software version 1.04 (2009)*
- 5) *Toxicological reports and SGV technical notes*

The CLEA Guidance can help suitably qualified assessors to estimate the risk that a child or adult may be exposed to a soil concentration on a given site over a long period of exposure that may be a cause for concern to human health. The CLEA Guidance does not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures. Nor does it cover risks to the environment or the pollution of water.

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The CLEA Guidance describes the soil concentrations above which, in the opinion of the Environment Agency, there may be concern that warrants further investigation and risk evaluation for both threshold and non-threshold substances. These levels are a guide to help assessors estimate risk. It does not provide a definitive test for telling when risks are significant.

Regulators are under no obligation to use the CLEA Guidance.

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